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2 December 1982

WEST EUROPE REPORT
SCIENCE AND TECHNOLOGY

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CONTENTS

BIOTECHNOLOGY

FRG Will Redirect, Intensify Efforts in Genetic Engineering (VDI NACHRICHTEN, 13 Aug 82)	1
Schering Joins Growing Group of Genetic Research Companies (WIRTSCHAFTSWOCHE, 1 Oct 82)	3
Short History of Biotechnical Research in Great Britain (FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT, 18 Oct 82)	5
Industry, Research, Government Biotechnology Program (BERLINGSKE TIDENDE, 21 Oct 82)	8

ENERGY

Three Coal Liquefaction Pilot Projects Discussed (ENERGIE, Jun 82)	9
Bottrop Plant, by E. Wolowski, O. Funk Saar Plant, by R. Thomas, H. Wuerfel Veba Oil Plant, by G. Escher, H. Hosang	

INDUSTRIAL TECHNOLOGY

Robotics Commission Makes Recommendations for Catching Up (ELECTRONIQUE ACTUALITIES, 3 Sep 82)	19
---	----

TRANSPORTATION

Roll-Out of Saab-Fairchild SF-340 in Linkoping (NEUE ZUERCHER ZEITUNG, 30 Oct 82)	21
All 1983 Saabs Will Have New Nonasbestos Brake Systems (Aar Wermes; AFTENPOSTEN, 14 Sep 82)	23

BIOTECHNOLOGY

FRG WILL REDIRECT, INTENSIFY EFFORTS IN GENETIC ENGINEERING

Duesseldorf VDI NACHRICHTEN in German 13 Aug 82 p 1

[Text] The Federal Ministry for Research and Technology (BMFT), which has 1983 biotechnology development funds amounting to 14.5 percent more than those for the previous year, wishes to establish new emphases in its development program. In presenting his budget for 1983, Dr. Andreas von Buelow, the federal minister of research, said that it was not only a matter of achieving a high scientific standard but also ensuring industrial connections at the proper time.

The biotechnology performance plan of the BMFT encompasses the years 1979 to 1983. In other words, it must now be renewed. The development of a number of programs and projects terminates in 1983, i.e., the project involving pest control with natural substances. New emphases will take their place or old ones will be expanded in specific directions. Reference is made to research on plant and animal cell culture technology which in the future will be concerned more intensively with material production. Genetic engineering, which to date has been worked on in isolated projects only, will be the object of a more systematic focus in the future.

The opportunities for this are being made available by cooperative arrangements between German enterprises and research institutions started in accordance with Hoechst-Harvard-Schock. After Bayer AG, Leverkusen, had made an agreement with the Max-Planck-Gesellschaft at the end of May for genetic engineering projects to be performed jointly at the Max-Planck Institute for Breeding Research in Cologne, for which Bayer will make available one million DM annually for 3 years, BASF Ludwigshafen made an agreement with Heidelberg University to provide one million DM annually for 5 years for genetic engineering research. In Heidelberg, there is some idea of setting up a biotechnological "industrial park."

In the joint development of these installations, the BMFT sees industry's role as including a contribution to the personnel costs for top researchers. This development is noteworthy in that industry is now more interested than before not only in project development but also basic research. The ministry is interested in greater promotion of joint biotechnology research by a group of companies.

In cooperation with the German Academic Exchange Service, the BMFT wants to try and stop or even reverse the emigration of biotechnology scientists to the United States. A special stipend program is intended not only to facilitate specific-term stays of German researchers in the United States, but also to make it possible for foreign scientists with special methodological knowledge to work in Germany for 1 to 2 years. Finally, there are to be research grants for German biotechnologists returning from abroad.

The BMFT will not take the initiative in establishing genetic engineering firms. Its development will be concentrated on specific scientific foci; requests will be evaluated within the customary scope of project development processes. On the other hand, the "Fund for Biological Chemistry" just established by the chemical industry will act in a "surface-covering" manner. An amount of 3.6 million DM is to be made available over the next 2 years. This fund functions according to the principle of the chemical industry fund: Basic research will be promoted, without any relationship to application and without any research programs.

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CSO: 3698/54

BIOTECHNOLOGY

SCHERING JOINS GROWING GROUP OF GENETIC RESEARCH COMPANIES

Duesseldorf WIRTSCHAFTSWOCHE in German 1 Oct 82 p 136

[Text] Genetic engineering, the scientific field of the future, is being established the world over. Among the German companies, Schering is taking a significant step into the future, with the help of the government.

A field which has advocated mutation is itself mutating. While a new group to ensure genetic engineering (cf. sidebar) is forming in Sweden, Schering AG is establishing an institute for genetic engineering research in conjunction with the District of Berlin.

Genetic engineering has for a long time been the object of both multiregional and worldwide cooperation and rivalry. For example, since 1981, Hoechst AG has been promoting research in genetic engineering at Harvard University. And Denmark's Nova Industry pulled a triple coup in May 1981: As a result of a stock sale on the New York Stock Exchange, the clever Danes not only acquired international capital but also the respect of the American competitors Eli Lilly and Miles Laboratories, and that of Gist-Brocades of the Netherlands.

The international debate over the best starting places for the genetic engineering field of the future results from its possibilities which cannot even be evaluated in terms of their inception (WIRTSCHAFTSWOCHE 37/1980). For 1990, the market volume is estimated at a worldwide total of 7 billion DM, and for the year 2000 the figure is astronomical. The causes: Innumerable products in the chemical industry can be produced more cheaply with genetic technology. However, the fact that entirely new substances can be obtained would appear to be even more important.

This also explains the hunt for patents. It has been said that the American company Genentech has already registered 500-600 patents all over the world. Schering is following a somewhat different course than Genentech with the newly established Berlin institute: The expenses of 80 million DM which have been estimated for 10 years are to be divided equally within the District of Berlin, and in addition to that federal funds will also be used. The institute is to maintain divisions for microbiology, biochemistry and molecular genetics. Schering's approach is "to do justice to the breadth of the subject with the multiplicity of the research projects."

[Sidebar:] Swedish Involvement

The Swedes also want to participate in the worldwide boom in biotechnology. The machinery plant Alfa-Laval AB and Cardo AB, the sugar producer, have formed a joint company, Biotechnics AB, which is to have a starting capital of 50 million Swedish kroner (approximately 20 million DM). The company is intended to bridge the gap between the results of genetic research and its industrial application. It has been a long time since biochemists were concerned solely with the creation of resistant grain varieties and yield-increasing feeds. The know-how of the companies establishing the new firm is promising for Biotechnics. Alfa-Laval has experience in food production while Cardo will contribute knowledge of genetic engineering. The new company is to start operation in 1983. Sales goal for the first year: 100 million kroner.

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BIOTECHNOLOGY

SHORT HISTORY OF BIOTECHNICAL RESEARCH IN GREAT BRITAIN

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German
18 Oct 82 p 7

[Text] London, 17 October (vwd). The euphoria of recent years, which had put biotechnology alongside microelectronics as the trailblazing innovation of this century, has evaporated. The enormous application potential of biotechnology has of course not been lost with it. Biotechnology has existed for six millennia, under other names, since bread has been baked, beer brewed, and cheese made. It was nevertheless not until the 1940's that the incidental products of micro-organisms became controllable through microbiology. With manipulation and the transfer of genetic codes from one organism to another biotechnology made a breakthrough in the early 1970's. But it is a longer road from the laboratory experiment to industrial exploitation. In addition it was quite overlooked that a market had to be created for the new products, with the possible exception of medicines.

Little Success in Protein Production

Already in the 1960's the oil companies BP [British Petroleum] and Shell went into biotechnology, since they wanted to produce protein industrially. Both gave up the project. They are now concentrating on the use of bacteria in oil conversion and extraction. ICI [Imperial Chemical Industries] has also been trying for 14 years to produce single cell protein for animal feed (Pruteen) and has invested 40 million pounds sterling in it at Billingham. Since the yield now as before leaves much to be desired, ICI is now going into genetic engineering.

Other British enterprises have also been active for years in biotechnology, including the flour and bakery products manufacturer Rank Hovis McDougall for the past 18 years. Among the others are the chemical firms Glaxo and Beechan, the cane sugar enterprise Tate & Lyle, the breweries Allied Breweries and Grand Metropolitan, the food products firm Spillers/Dalgety and the machinery manufacturer John Brown. While Tate & Lyle have already again reduced their commitment to biotechnology, Grand Met has started off in a new direction. They have been participating, to the extent of 4 million pounds sterling, in the Swiss Biogen. All the same, the hopes that Biogen would build a plant in Great Britain because of the British link have not been fulfilled.

Attempts At a Realistic Exploitation

A few weeks ago 4 firms, John Brown, Dalgety, Gallaher, and Whitbread, decided to break a basically new path in the direction of biotechnology. They supported the research at the biocenter of the University of Leicester. The University of Swansea also works closely with the British biotechnology firm Bio-Isolates, which produces food additives based on protein. This small firm, whose shares were introduced only in July, has a patented process for the extraction of pure protein from milk, which as a cheap raw material will be converted into alcohol, medicines, and feed additives with the help of recombined bacteria.

The other British biotechnology firm, Celltech, is undertaking a more realistic approach to the exploitation of the results of research. It is concentrating on two fields, DNA recombination and cell hybridization, in which the research results will be developed into industrial utilization. Two thirds of the effort are aimed at health protection and hygiene. The main sources of income are research contracts from industry, sale of interferon, and issuance of licenses. Celltech is the only British enterprise which conducts DNA splitting.

The Genetic Manipulation Advisory Group (GMAG) exercises surveillance to ensure that there is no abuse of the roughly 10,000 biotechnical patents which were registered in Great Britain between 1970 and 1908. 103 research and production sites active in biotechnology are registered, including the large users, G.D. Searle in High Wycombe, ICI in Billingham, and Dista in Liverpool. GMAG, which was brought into existence 3 years ago demands that it be informed at the earliest possible stage if work is to be carried out with the purpose of placing genetically manipulated organisms or plants in the environment. GMAG members are furthermore instructed to provide detailed data on experiments and field tests. The early fears that broadly disseminated microorganisms unintentionally might be converted into dangerous species have nevertheless proven groundless. Virtually all gene manipulations can in the meantime be undertaken with "enfeebled" cell components, which are capable life only under certain conditions or for only a short time.

The intensified efforts in the field of biotechnology have led in Great Britain also to the founding of the British Coordinating Committee for Biotechnology (BCCB), which was put together in 1978 from 7 individual associations. The most recent task of the industry association is to devote itself to the coordination of private industry and government projects. In order to prevent in biotechnology the same sort of failure as occurred with the government supported excursion into office technology of the future, Minister of Industry Patrick Jenkin not long ago made the prudent attitude of the government clear: "The government must support basic research where commercial exploitation is not evident." The multi-party committee of the lower house for biotechnology even determined that basic research is in danger.

Deficiencies in Basic Research

The Committee for University Assistance is particularly in no position to cover the funding needs of the research councils. In actuality basic research in Great Britain is in a bad way not only in biotechnology. Hardly any comprehensive and conscientious research is being conducted except at the universities of London,

Oxford, and Cambridge. Private industry prefers to invest in licenses and in purchases of firms with the appropriate know-how. This is precisely what has been established by a joint study of the Advisory Council for Applied Research and Development (ACARD), the Advisory Board for Research Councils (ABRC), and the Royal Society. British industry, it says, has up to now been incapable, unwilling, or insufficiently alert to seize upon the advantages of the potential of biotechnology.

It says that investments have been low and opportunities to create and deliver products domestically and abroad have been missed. Industry must react more rapidly to challenges and to reverse the trend which has begun for foreign firms to be more ready than the British to exploit the expertise of the universities and research laboratories. Some of the competitors of the British in Germany, Japan, and America have already clearly invested more in the development of biotechnology.

One of the main reasons for the slow British reaction is the poor coordination. Industrial success and growth depend to a great extent on the adequate resupply of trained workers and the flow of research data from a series of various disciplines. Along with this, says the study further, the multiplicity of the applications of biotechnical products indicates an obstacle in that the resources are relatively thinly sown. Many people and organizations in Great Britain are said not to be aware of the importance of this potential. After Great Britain fell asleep at the switch with regard to microelectronics, the country is in a fair way to miss out on biotechnology as well.

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BIOTECHNOLOGY

INDUSTRY, RESEARCH, GOVERNMENT BIOTECHNOLOGY PROGRAM

Copenhagen BERLINGSKE TIDENDE in Danish 21 Oct 82 p 5

[Item reported from London: "Cooperation Between Industry and Research"]

[Text] Sweden's largest bioengineering and chemical firm, Fortia in Uppsala, recently agreed to participate in a 6-year bioengineering research program in cooperation with Uppsala University.

The Swedish government, through STU, the Swedish Technical Development Council, will share with Fortia the expenses for the program to the tune of 36 million Swedish kroner. Such cooperation between industry, research and the government is unusual in Sweden.

The goal of this work is to gain a better insight into the function of living cells. They are very important to chemical firms for the manufacture of many different chemical and medical products in the most energy-saving and often environment-protective manner.

The research will take place at Uppsala University's Institute for Cell Research under the direction of Professor Per Peterson, but some of Fortia's leading scientists will be part of the research group.

All research results will--in any case the theoretical--be accessible to any firm, but Fortia will receive first rights to the group's results.

However, Fortia is not basing its future in the bioengineering field but aims to become a supplier of equipment and materials to firms, e.g., Celltech and Biogen, which concentrate on the manufacture of new forms of bioengineering medicine.

Professor Kurt Skagious, who is Fortia's vice-director and chairman of the Swedish Association of Bioengineers, says that the biggest problem for bioengineering firms is to extract the chemicals which are produced in cells.

"The methods we know today for extracting chemicals can be compared with smashing cells with a very big hammer," says Professor Skagious. "Then we rummage about in the remains to find what we will use."

Therefore, the research group will only draw upon the department involved in separation of chemical products for the pure production of bioengineering components.

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THREE COAL LIQUEFACTION PILOT PROJECTS DISCUSSED

Bottrop Plant

Graefelfing ENERGIE in German Jun 82 pp 169-170

[Article by E. Wolowski, O. Funk, Bottrop*: "Coal Oil From Bottrop"]

[Text] "Presently not economical" reads, of course, the result of the Ruhr Coal study concerning the construction of a full-scale coal liquefaction facility. Nonetheless, according to RAG, there can be no let up in this field if the FRG is to maintain its technological lead. The 200 t/d Bottrop installation can contribute to process optimization and component development. However, construction of a full-scale facility remains indispensable at least as a reference facility for export contracts.

The German development of the process for liquefaction of hard coal is based on the IG process which was commercially tested in Germany until 1945. However, the process has been modified in the following significant aspects:

- Pressure reduction from 700 to 300 bar,
- Separation of reaction products by distillation, and
- Production of hydrogen by gasifying process residues.

An increase in thermal efficiency, and thus economy, is expected from process improvements and improved heat recovery.

After German laboratory tests of the process, two pilot plants--the Saar Mining Company's 6-t/d installation and Bottrop's 200-t/d plant--were built. The Bottrop coal oil pilot plant is presently the largest coal hydrogenation plant in Europe and has a capacity comparable to plants in the United States.

It is situated next to a coking plant which delivers the coal for processing via a reversible belt conveyor. Process residue is also removed by the same

*Dr Ing Eckard Wolowski, Dr rer nat Otto Funk, Ruhrkohle Oel und Gas GmbH, Bottrop

It is situated next to a coking plant which delivers the coal for processing via a reversible belt conveyor. Process residue is also removed by the same conveyor. The hydrogen required for liquefaction is drawn from a pipeline belonging to the Hüls Chemical Company AG which runs along the property line of the plant.

200 Tons of Ruhr Coal Yield 98 Tons of Coal Oil Daily

A highly volatile coal from the Ruhr district designated as standard coal is initially planned to be the conversion coal for Bottrop; however, other coals will also be processed in the pilot plant (Table 1). Table 2 shows data on process materials and products for standard coal. The data are based on test results of the continuous laboratory facility of Mining Research GmbH in Essen.

The coal, dried to less than 1 percent by weight and ground to less than 1 mm, is mixed with coal produced in the process and wet milled to a particle size of less than 0.2 mm with simultaneous addition of the iron catalyst. The finished mash is compressed to 300 bar and heated together with fresh hydrogen and system gas to 425 degrees C. This reaction mixture ascends through three reactors in which at 300 bar and a maximum of 475 degrees C the exothermic hydrogenation reaction--the cracking of the coal into gaseous and liquid products--takes place.

Table 1: Specification for Conversion Coals

	<u>Standard Coal</u>	<u>Range</u>
Short Analysis:		
Ash (percent by weight, water free)	4.5	3.0--17.0
Volatile constituents (percent by weight, water and ash free)	37.9	10.0--53.8
Elementary Analysis:		
(percent by weight, water free)		
Carbon	84.3	75.0--93.0
Hydrogen	5.0	3.5-- 7.0
Oxygen	7.2	1.5--17.8
Nitrogen	1.7	1.0-- 1.9
Sulfur	1.7	0.5-- 5.4
Maceration Composition:		
(percent by volume)		
Vitrinite	64	61 --77
Exinite	17	5 --20
Inertinite	14	1 --14

Table 2: Process Materials and Products (Standard Case)

Process Materials:

Coal (water and ash free)	200	tons/day
Catalyst (Fe_2O_3)	4	"
Hydrogen	220,000	m^3/day

Products:

Gases (C_1, C_2)	22	tons/day
Gases (C_3, C_4)	18	"
Light oil (200 deg C)	22	"
Medium oil (200-325 deg C)	69	"
Heavy oil (greater than 325 deg C)	--	"

Separation of the reaction products takes place in the adjoining separators. The top product of the hot separator is separated into light-, medium- and heavy-oil fractions after condensation. The noncondensable fraction is recirculated as system gas after washing. The sump product of the hot separator contains all solid residues, thus the coal ash, the unconverted coal and the spent catalyst. After decompressing the hot separator, the sump product is processed into heavy coal oil and residue by vacuum distillation. The coal oil is used to prepare the coal sludge; the hot fluid residue is poured onto a cooling conveyor where it solidifies. At the end of the cooling conveyor, the residue is crushed and moved to the coking plant.

Initial "Coal-In," November 1981

The operational phase of the Bottrop coal oil plant started on November 25, 1981. This was the day of the initial "coal-in." By the end of 1981, several test runs with coal had been completed during more than 300 hours of operation under relatively mild conditions below the design values to shake down the initial complement of parts and equipment. Problems which were encountered and fixed during this period occurred mainly in the hydrogen compressors and in the decompression system.

During the tests which continued into the first quarter of 1982, problem parts were improved. By this time, the facility had logged about 2,000 hours with coal and had processed about 8,000 tons of coal. Also, during this period coal throughput was upped to the design value. Initial test tuning runs will be completed by the middle of 1982.

The goal of further development work on the catalytic coal hydrogenation process is the construction and operation of industrial facilities. In this, the Bottrop coal oil facility is a link in the required development chain for minimizing the technical and economic risks. The transition from this large-scale test plant to an industrial hydrogenation complex can be accomplished with the current design concept and a throughput scale-up factor of 1 to 12.5 is considered feasible.

Further Development of System Components Necessary

In addition to optimizing process parameters, testing and further development of plant components which do not reflect the state of generally available technology are focal points of the experimental operation of the Bottrop facility. Examples of such equipment items are sludge pumps, heaters and reactors used in hydrogenation.

High-pressure sludge pumps bring the coal/oil suspension up to the pressure required for hydrogenation. Due to the high solid content of the sludge, the pumps must meet stringent requirements to protect against abrasion. Three different high-pressure piston pumps have been installed for evalutaion in the Bottrop plant. Each pump has three parallel pistons. In two pumps the pistons are arrayed vertically; in the third, horizontally.

In the pumps the valves are opened by oil columns supplied with fresh oil, a portion of which is lost and must be replenished during each cycle of the piston. This type of hydraulic actuation permits abrasion-free piston operation.

During heating the coal strongly absorbs the solvent. In this gel phase the viscosity of the coal/oil suspension increases whereas it should actually decrease with increasing temperature. It reaches a maximum at 300 to 350 degrees C and only then decreases, falling off sharply aided by the onset of the chemical decomposition of the coal. In the region of high viscosity, heat transfer degrades substantially due to laminar flow increasing the coking tendency. For this reason, special attention must be given to designing the peak heater. Two different types of peak heaters, a rolling gas and a radiant heater, were installed in the Bottrop plant.

In the case of the rolling-gas heater, heat transfer is by convection produced by blowing hot combustion gases across a row of connected hair-pin-like tubes which carry the coal/oil suspension. The heat transfer efficiency is relatively low, minimizing the coking propensity of the coal/oil suspension in the hair-pin tubes. Disadvantages of this type heater are its size and cost. The danger of coking is greater in the case of radiant heaters due to the higher temperatures produced. The reduction of this risk through use of higher heat tranfer values, smaller size and lower investment cost is the objective of the operational tests in the Bottrop installation.

The hydrogenation reactors are multilayer containers which for reasons of cost are provided with internal insulation. This insulation is protected from solid-material erosion by the coal/oil mixture by a thin-walled metal shell. During operation gas, especially hydrogen, penetrates from the reactor chamber into the space behind the metal shell and into the insulation layer, filling all cavities at operational pressure. In order to ensure that the gas flows back into the reactor chamber when pressure is reduced, the metal shell is provided with pressure equalization ports.

Although pressure equalization in the insulation layer is accommodated during gradual depressurization, this is not true during rapid depressurization and

an over-pressure condition can develop in the insulation layer which can cause mechanical deformation of the metal shell in the reactor cavity. Depending on the degree of deformation, the internal insulation can come loose with the result that the pressure-bearing multilayer external shell is no longer insulated at all points. In order to prevent local overheating of the reactor pressure vessel during subsequent operating cycles after the insulation has failed, the reactor has to be removed from service and the internal insulation along with the internal metal shell must be replaced. A new type of reactor is being developed which does not exhibit this disadvantage due to pressure cycling, especially upon depressurization. Thus it promises to have high availability and a long service life. An important feature of this development is a pressure-bearing metallic support shell between the insulating material and the reactor chamber. Installation and testing of this type reactor is planned at Bottrop.

Feasibility of Large-Scale Coal Hydrogenation Investigated

The construction of production facilities is technically feasible; however, their operation is presently uneconomical. This is a conclusion from the pilot project "Large-Scale Coal-Oil Facility, Ruhr" for the construction and operation of a large-scale installation for the production of coal oil by a catalytic process which was accomplished under a contract from the Minister of Economics, Infrastructure, and Transportation of the state of Nordrhein-Westphal.

The Large-Scale Coal-Oil Facility, Ruhr was designed as a complete hydrogenation plant with all required ancillary and material refining installations. The intended conversion material is an open-burning coal of the Ruhr region. The design takes into account that the composition of the conversion coal will vary over the ranges listed in the specification of Table 1.

Possible locations for constructing the large-scale plant lie in the Ruhr district where an adequate transportation infrastructure is in place. Plans call for continuous plant operation 330 days per year.

The pilot project of Ruhr Coal AG investigated plants with coal throughputs of 3.3 and 6.6 million t/y of water-and-ash-free hydrogenation coal for the production of 1.5 and 3 million t/y of light and medium oil. This corresponds to daily throughputs of 10,000 and 20,000 tons of water-and-ash-free hydrogenation coal. The plants have two and four hydrogenation lines, respectively. The resulting gasoline price from large-scale plants of this type is DM 2.09.

Even though commercial coal liquefaction plants are not yet economical, advantage should nonetheless be taken of the present "breathing room" in energy markets to further develop coal hydrogenation technology. For this purpose, a technically and financially realizeable plant with a daily throughput of 2,500 tons of water-and-ash-free hydrogenation coal could serve as a reference facility using commercial plant components.

Mentioned in conclusion is the economic importance of commercial facilities for employment, technical innovation and development of alternatives to OPEC dependence.

Saar Plant

Graefelfing ENERGIE in German Jun 82 p 171

[Article by R. Thomas and H. Wuerfel*: "Coal Liquefaction Will Grow Into Profitability"]

[Text] Of the three studies reported relating to the economic feasibility of coal liquefaction in the FRG, that of the Coal Liquefaction Company, in which the Saar Mining Company and the BP subsidiary Gelsenberg participate on a 50-50 basis, produced the "most satisfactory" results. For the Saar coal gasoline, a pump price of about 2 DM/l would cover operating costs. The differing results of the planning studies may be due only in part to differences in the processes investigated; they are possibly due also to different methods for calculating economic performance. But also the Saar study, which was carried out with primary support from the BMFT, shows the same trend of the other studies: A large-scale facility for coal hydrogenation can only be realized by the injection of public funds.

In 1974 the Saar Mining Company AG undertook the further experimental development of the proven IG Farben process for direct liquefaction of coal. On this basis, a process concept for a large-scale plant for producing gasoline from hard coal was worked out and in 1980 BASF was contracted as general engineer to conduct additional engineering work related to optimizing this process concept. The "Planning Study" which was submitted to the Coal Liquefaction Company in installments was completed at the end of 1981.

Super Gasoline from Coal with a Pump Price of 2 DM/l

The planned facility has a coal conversion capacity of 1.9 million t/y. As an additional hydrogen source, 0.26 million t/y of coking plant gas is used. For producing a super gasoline which complies with specifications, 0.17 million t/y of blending components are necessary which must be bought. The hydrogenation facility's 150-MW electrical power requirement will be covered from an outside source.

From the raw materials, 1.3 million t/y of products will be produced, specifically:

*Dipl Betriebswirt Dipl Hd1 Reiner Thomas Business Manager; Dr Ing Dipl Ing Helmut Wuerfer Business Manager, both of the Coal Liquefaction Company, Saarbruecken

--0.9 million t/y of super gasoline (0.73 t/y of coal gasoline and 0.17 t/y of blending components)

--0.1 million t/y of liquid gas

--0.3 million t/y of synthetic natural gas.

About 1,500 employees will be required for administration, operation and maintenance. The space requirement is about 115 hectares. Considering the amount of research and development work still required, the earliest possible completion date for the large-scale facility is 1989.

The sump phase of the hydrogenation facility is a two-line design and works at a maximum pressure of 300 bar. The facility is thermodynamically so optimally designed that no preheating oven is required for heating the coal sludge. Further processing of the sump-phase coal oil into gasoline is accomplished in a single-line process using the same steps as in the petroleum industry: refining, hydrocracking and reforming. The hydrogen requirement will in general be covered by gas from a coking plant.

The hydrogenation facility is believed to be certifiable under the applicable environmental regulations. Emission projections based on propagation calculations show that the allowed emission levels--including existing preloading--will not be exceeded during plant operation at the Saarland sites studied.

The investment requirement for the hydrogenation plant in 1981 money is DM 2.8 billion. Projected taxes and interest during the construction period plus start-up costs increases this amount to 3.4 billion. Economic feasibility calculations based on present costs and taxes show that a pump price of about 2 DM/l will have to be sought to cover operating costs.

The future competitiveness of coal oil products will be largely determined by the relative price developments between coal on the one hand and the competing petroleum products on the other. In spite of many prediction uncertainties in the energy sector, it is assumed that in the long run the price of petroleum will increase faster than the price of coal and that the liquefaction of coal will eventually become economical.

Hydrogenation Technology Must Be Tested in Large-Scale Facilities

If the modified hydrogenation technology which has not yet been tested in large-scale facilities is to be demonstrated in prototype facilities soon enough to present an option on the way "away from oil" and to ensure German industry's lead in this technology, then development and construction of prototypes has to be undertaken today in spite of the fact that profitability is not yet assured. However, this can be done by private business only with appropriate support from government.

Veba Oil Plant

Graefelfing ENERGY in German Jun 82 pp 172-173

[Article by G. Escher and H. Hosang*; "Coal Oil, a Subsidy Business"]

[Text] It takes 20 volumes to hold Veba Oil's preliminary study on the realization of a large-scale hydrogenation plant in the FRG. Involved in considerations of method, economic feasibility, environmental compatibility and site selection were the firms Lurgi, Linde, Veba Power Ruhr and Hüls Chemical company. The study, which cost DM 12 million (half paid by the BMFT) came to the conclusion that the hydrogenation of coal will not be economical in the foreseeable future without public subsidy.

From 1936 to 1945 hard coal was being converted into liquid hydrocarbons at the Schloven and Horst plants which today belong to Veba Oil. Hydrogenation was accomplished in two steps, the sump phase and the gas phase, with intervening complete condensation and expansion of the raw products (Bergius-Pier process).

After slight modifications to these facilities which were built for coal hydrogenation, petroleum residues were hydrogenated in the period 1952 to 1964. This led to the development of a process which is known today as Veba-Combi-Cracking and in which the direct combination of both hydrogenation processes is realized. This process was carried over to coal hydrogenation and forms the basis of the feasibility study.

For the large-scale facility, four parallel hydrogenation lines are provided. Hydrogen production is accomplished via three parallel gasification installations and one cracking unit in which a part of the C₁/C₂ gas resulting from hydrogenation is used. Through the multiline design of the most important sub plants, high availability of the overall facility can be achieved. Even though all four hydrogenation lines are basically planned for the use of coal, two of them were designed so that heavy oil can also be used.

This combined design has the following advantages:

- Flexible operation corresponding to the market and cost situation of the raw materials,
- Distinctly lower operational losses than in a pure coal hydrogenation plant,
- Contribution to further refining of conventional petroleum through conversion of the heaviest refinery residues into fuels, light heating oil and chemical raw materials,

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--Instant availability for 100-percent coal throughput, for example in times of crisis.

From 4.3 Milltion Tons of Coal, 1.7 Million Tons of Gasoline per Year

Using 4.3 million tons of coal per year, the overall facility will produce about 1.6 million tons of gasoline and light heating oil per year as marketable finished products. By using top residue (an example of operating with heaviest oil) vacuum-gas oil is extracted from one of the hydrogenation plant's prestige vacuum distillation units. The remaining vacuum residue is converted into light hydrocarbons in the hydrogenation unit. Since in this case the hydrogenation unit in particular can be more highly loaded, additional syncrude is produced which along with the vacuum-gas oil can be further processed into finished products in available outside refineries.

Within the scope of the study, a total of ten locations were investigated, five inland and five on the coast. In the Ruhr region the Rheinberg site is well suited due to its favorable infrastructural connections. The same holds basically, in spite of several infrastructural disadvantages, for the Dortmund-Ellinghausen location. Brunsbuettel is regarded as a favorable location on the North Sea coast.

The realizability of the facility at all locations is not assured politically. Public resistance has the potential to significantly delay, if not to stop construction altogether.

Applicable Environmental Protection Regulations are Met

The plant can be built and operated within the scope of the applicable environmental-protection regulations. For gaseous and particulate emissions, the requirements of Technical Guideline, Air (TG, Air) are not exceeded. This may however become questionable in view of the clearly more stringent authorization conditions which could result from the present discussions of the proposed changes to TG,Air.

Noise emission can be held within the limits prescribed by TG,Noise by applying special protective measures which, of course, go far beyond the present state of technology. Waste water from the process will be subjected to multistage biological processing after recovering phenols and ammonia. The granulate resulting from gasification of the residue has a closed surface and is considered neutral in its effect on ground water at waste disposal sites.

Economic Feasibility Not Seen in Foreseeable Future

The cost estimate showed an investment of DM 6 billion (in 1981 DM); through interest and taxes during the 8-year construction phase, the total capital at interest increases to about DM 7.7 billion.

The use of German coal generates an annual subsidy requirement of about DM 1.4 billion. This calculation holds for a gasoline price of 1.50 DM/l and

a light heating-oil price of 0.75 DM/l (status of October 1981). Neglecting subsidies the pump price required to cover costs is 2.20 DM/l for gasoline and an associated heating oil-price of 1.61 DM/l. By using imported coal the annual subsidy requirement decreases to DM 1.1 billion. Without subsidies the price for gasoline is 2.05 DM/l and for light heating oil, 1.45 DM/l.

If two lines of the hydrogenation plant are supplied with heaviest oil, then the annual subsidy drops to about DM 0.9 billion with use of German coal (1.92 DM/l for gasoline, 1.36 DM/l for light heating oil) and to about DM 0.8 billion with use of imported coal (1.85 DM/l for gasoline, 1.28 DM/l for light heating oil).

For the production of gasoline exclusively from German coal, the subsidy requirement increases to about 1.5 billion DM/y. In this case the gasoline price amounts to 2.37 DM/l including all taxes and distribution costs.

Overall, the study shows that the hydrogenation of German hard coal alone and in combination with heaviest oil using the Veba Combi Cracking process (a further development of the Bergius-Pier process) is realizeable on a large scale in Germany. This still holds even when environmental-protection requirements are included. The amendment of TG,Air which is presently under discussion would distinctly tighten the authorization conditions and additionally--possibly greatly--complicate the realization possibilities of the project.

The facility requires a relatively large tract of land and good transportation connections so that realization is possible at only a few locations in the FRG. Basically, however, locations are available at which the facility can be built even taking into account existing emission pollution levels if local resistance can be defused. A large-scale installation of this type serving as a reference facility would bring significant advantages to German industry. However, the absence of profitability today and in the foreseeable future does not allow this project to be realized in the private economy under conditions prevailing today.

9160
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INDUSTRIAL TECHNOLOGY

ROBOTICS COMMISSION MAKES RECOMMENDATIONS FOR CATCHING UP

Paris ELECTRONIQUE ACTUALITIES in French 3 Sep 82 p 4

[Article: "Robotics Commission: Nine Proposals for Catching Up."]

[Text] The Robotics Commissions conclusions which its leader, Mr Petiteau (chief executive officer of Sormel and Jaz Industrie, in the Matra group) placed on the desk of the minister of research and industry in July will serve as a basis for the production plan initiated by the minister. The declared objective is "to give France competitive robotics industry performing in the domestic and foreign markets, making it independent of the principal industrialized countries."

An ambitious objective if one considers the rather negative observation taken from the commission report: the imported share of the domestic market, a market estimated at over 8 billion francs in 1982, reaches an overall 65 percent for all automation. The most disturbing figures concern CAO [Computer Assisted Design] (90 percent of the market controlled from abroad, systems (80 percent), industrial calculators (60 percent) and the so-called "advanced design" machine group (60 percent). Finally, it is robots again which are the least unfavorable to national industry with a planned import rate for 1982 of 50 percent. The situation is characterized by the number of flexible automated shops operating in France: 2 (and about 10 projects) compared to 50 to 100 in Japan, 50 in the United States and 70 in the FRG. There are, however, some positive points which are decisive trump cards: a very high level of research and a first-rate service and engineering industry, for example.

In order to catch up quickly, the commission estimates the investments required over three years at 2.4 billion francs (compared to 500 million francs invested for the past 3 years). The commission views that sum as not very large considering the expected gains in productivity, on the order of 10 billion francs, for industries downstream.

Regionalization

Nine proposals have been set out:

--The creation of an Interministerial Robotics Committee (CIR) which would broaden the functions of the CODIS [Steering Committee for Development of Strategic Industries], coordinate all activities and manage the funding

allocated. However, let us note that this proposal has little chance of being accepted, the functions of such a committee should rather be encompassed in a broader structure within the production plan.

--Establishment of competent regional centers around existing structures (ADEPA [National Agency for the Development of Automated Production]) engineering schools, laboratories, technical centers, builders and users. The first two such centers will be Besançon, with a specialization in light robotics and perirobotics and the planned creation of an Institute for Automated Production, charged at the national level with the qualification of components; and Toulouse, with the launching of a structure called Midi-Robots, charged with the coordination of developments with a strong computer and software component. The financial resources recommended for the two centers: 75 million francs a year. Other centers could follow at Nancy, Strasbourg, Aix, Marseille, Tarbes and Nantes.

--Five subjects of priority research will be instituted: automation and advanced robotics, continuation of the ARA [Automation and Advanced Robotics] project with emphasis on artificial intelligence (proposed budget: 80 million francs over 3 years); components (150 million francs over 3 years) with emphasis on probes, motorization and kinematics; study of the social and economic consequences of automation (5 million francs), automation of continuous processes (20 million francs); the fifth theme would treat the relationship of robotics to other disciplines, data processing, electronics (developments of specific integrated circuits), mechanics (the machine tool plan) and optics, around the use of the laser, 45 million francs being devoted to these activities.

--Pilot operations in the area of flexible shops would be set up. The activities proposed are: small electrical motors for the automobile, electronic cards and circuits, assembly of electrical components, and soon. Budgetary provisions would be 258 million francs.

--Specialized training within existing establishments (30 million francs over 3 years).

--Creation of new information and promotional circuits, starting with existing organizations (AFRI [French Association for Industrial Robotics], SEE [Electronics and Electrotechnical Company], ISF [expansion unknown], AFCET [French Association for Economical and Technical Cybernetics]).

--Implementation of qualification procedures and development of standards (60 million francs).

--Creation of new relay structures with the reinforcement of regional centers of the ADEPA [Association for the Development of Automated Production] and the help of the creation of the Society for Robotics Services and Advice (SSCR). Proposed budget: 120 million francs over 3 years.

--Implementation of a financing structure with extension of funding accorded by the ANVAR [National Agency for the Promotion of Research], the ADI [Computer Development Association] and within the framework of the MECA [Advanced-Design Machines and Equipment] procedure. This funding should "consolidate the automator and the automated."

TRANSPORTATION

ROLL-OUT OF SAAB-FAIRCHILD SF-340 IN LINKOPING

Zurich NEUE ZUERCHER ZEITUNG in German 30 Oct 82 p 7

[Text] King Carl XVI Gustav pressed the legendary button; the lights in the enormous hanger went out; trumpet fanfares, drum rolls; the curtain rose slowly to reveal the brightly lighted star of the ceremony: the Saab-Fairchild 340, the 34-seat aircraft for regional air transportation, with the Swiss cross on the tailfin and the Crossair name on the fuselage; from the spectators' perspective it could not be seen that the aircraft was painted on the other side in the colors of Air Midwest, the first customer from the United States.

About 500 guests from all over the world had come to the Saab-Scania aircraft works in Linkoeping in the central Swedish province of Oestergoetland for the roll-out ceremony; in the various speeches the main emphasis was on the importance of the Swedish-American cooperation, which Saab-Scania and Fairchild-Swearingen had decided on in 1980. Their project took shape in the remarkably short time of just under 2 years. The maiden flight is set for January 1983, and delivery of production aircraft is to begin in spring 1984. Crossair, which has ordered 10 SF-340's and has a one-tenth share of the current orders of about 100 aircraft, will receive the first one.

In The Updraft of Regional Air Transportation

In the last few years, regional air transportation has been in the grip of a powerful updraft. In the United States, where it was already extremely widespread, its development has been additionally favored by deregulation, and in Europe the need for this type of connecting flight has grown in large part because the major airline companies were forced to neglect them for economic reasons. Their smallest airplanes, the Boeing 737 and the DC-9, with 100 and more seats, are too large for the sparse volume of traffic away from the main air travel arteries, which normally are most active between the most important economic centers of the individual countries. For this purpose a smaller aircraft was required, with the appearance and comfort of a "real" passenger aircraft. The Fairchild-Swearingen Metroliner, for example, as used by Crossair, met these requirements to some extent. But, with 18 to 19 seats, it is already too small for certain regional air traffic routes.

In light of this situation, the construction of larger turboprop aircraft became more urgent. It was as obvious for Fairchild, following its good experience with the Metroliner, to turn to these types of plans as to form an alliance with a Euro-

pean manufacturer. At the time, Fairchild had built more than 200 Fokker F-27/227 Friendship aircraft as a licensee. What was more astonishing was the energetic activity in a civilian area of Saab of Sweden, which has made a name for itself up to this time almost exclusively with its military aircraft--the Draken, Viggen and, in the future, the JAS 39.

Economy in Capital Letters

The Saab-Fairchild 340 is a cleanly shaped small passenger aircraft; the fuselage, wings, engine and cockpit equipment conform to the most advanced state of technology. The cabin offers space for 34 passengers in 11 rows of seats--10 rows of 3 and, at the very rear, 4 seats in a single row; with a height of 1.83 ms, it will not force either the passengers or the stewardess, who will be part of the crew of the SF-340, to adopt a "necks-bent attitude" in the center aisle. The two turboprop engines (General Electric CT7), each with an output of 1,630 SHP [shaft horsepower], give the aircraft a cruising speed of about 500 kms/hour and are commended as being particularly quiet. With respect to fuel consumption in general, the SF-340 is said to be superior to every aircraft in a similar size category. The range covers an area of 1,500 kms.

Basically, Fairchild builds the aircraft's wings and the tailplane, Saab builds the fuselage. Final assembly takes place in a giant hangar in Linkoeping, which was built from scratch in just a few months. Almost one-half of the approximately 100 orders come from the United States. In 1984, 24 SF-340's will be delivered, in 1985, 43, and about 50 in 1986.

An Important Day for Crossair

With its order for five units and an option for another five--they have now been changed to firm orders--Crossair provided the initial spark for the construction of this aircraft in November 1980. Their plan requires investments in the magnitude of \$ 50 million. Crossair was able to negotiate particularly favorable terms as the "launching carrier;" it was suitably honored at the roll-out ceremony in Linkoeping. Director Moritz Surer paid tribute to the event in a cleverly worded speech; at its conclusion he and Crossair's administrative president, Dr Alfred Wiederkehr, gave the Swedish king a Crossair share as a present. The Swedish royal house is, therefore--at the moment at least--financially involved in Crossair; there is no reason to suppose that the name will subsequently be altered to "Royal Crossair."

There was state representation from Switzerland in attendance at the ceremony in Linkoeping. Crossair had chartered a CTA Caravelle for the occasion. Among the guests were members of the executive or legislative branches of the cantons of Basel, Tessin, Bern and Geneva and the cities of Lugano and Zurich and the director of the Office of Civil Air Traffic, Rolf Kuenzi; Swissair was not represented.

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TRANSPORTATION

ALL 1983 SAABS WILL HAVE NEW NONASBESTOS BRAKE SYSTEMS

Oslo AFTENPOSTEN in Norwegian 14 Sep 82 p 12

[Article by Are Wormnes]

[Text] The Saab factory will be launching something no one else has been able to come up with and that the Mercedes engineers called impossible on all its 1983 models: semi-metallic, nonasbestos brakes with better braking properties and a lifetime 3 to 4 times as long as that of standard braking systems.

This little Swedish car factory, which competes with the giants of the car market, has a certain talent for coming up with technical and safety innovations. Some past accomplishments are "collision-proof" bumpers, headlight wipers, a heated driver's seat and gasoline turbo engines. Many of the big companies have since followed suit, but Saab is still one of the smallest companies.

What is so special about nonasbestos brakes? Saab's testing chief for car bodies and brakes, Magnus Roland, told AFTENPOSTEN that 6 years of development and testing as well as a couple of lucky accidents lie behind the introduction of the new brakes--which can also be installed on older models. "Mercedes tested the device but could not use it on its brake systems. They said it was impossible to use metal fibers to replace asbestos. The brakes heated up too much. Saab solved these problems and can therefore offer an environmentally acceptable braking system with better braking properties and a lifetime 3 to 4 times as long as that of an ordinary system--we estimate it as being from 70,000 to 90,000 kilometers," he said.

Roland claimed that Saab has produced brakes that give maximum efficiency in all kinds of road conditions. "The braking efficiency is distributed between the front and back wheels with an automatic adjustment to the surface, without using valves, giving the shortest possible braking distance," he said.

Roland is convinced that competitors will follow them in this area too, but that it will take several years before they manage to do so. "They must make too many changes in their existing designs," he maintained.

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